PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TS 1268 PCT	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/EP2004/050016	International filing date *(day/month/year)* 14.01.2004	Priority date *(day/month/year)* 14.01.2003
International Patent Classification (IPC) or national classification and IPC H01M8/04, H01M8/02		
Applicant SHELL INTERNATIONALE RESEARCH MAATS... et al.		

1. This report is the International preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☐ *sent to the applicant and to the International Bureau)* a total of sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21.07.2004	24.05.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Wiedemann, E Telephone No. +49 89 2399-7542

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/050016

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-10	as originally filed
Claims, Numbers	
1-9	as originally filed
Drawings, Sheets	
1/2-2/2	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-9
	No:	Claims	
Inventive step (IS)	Yes:	Claims	4, 8, 9
	No:	Claims	1-3, 5-7
Industrial applicability (IA)	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Documents

D1: US 2002/142208 A1 (HUNTER CARL F ET AL) 3 October 2002 (2002-10-03)
D2: US-A-5 175 061 (SCHRAMM WALTER ET AL) 29 December 1992 (1992-12-29)
D3: US-A-4 917 971 (FAROOQUE MOHAMMAD) 17 April 1990 (1990-04-17)
D4: EP-A-0 376 219 (ISHIKAWAJIMA HARIMA HEAVY IND) 4 July 1990 (1990-07-04)
D5: US-A-5 084 363 (REISER CARL A) 28 January 1992 (1992-01-28)
D6: WO 02 065564 A (SAMUELS ADRIAN JAMES ;VIK ARILD (NO); AAM ONAR (NO); CLEAN CARBON) 22 August 2002 (2002-08-22)

2. Novelty

The subject-matter of claims 1-9 is considered to be new, Article 33(1) and (2) PCT, because no prior art document discloses a process in which the anode and cathode off-gases are partially recycled back to the cells after being treated by catalytic burning with an oxidant containing enriched oxygen, being heat exchanged and cooled. Especially the carbon dioxide enriched gas which is recycled from the cathode off-gas stream back to the cathode until a certain set point of carbon dioxide is reached and the CO_2 can be distracted.

3. Inventive Step

The present application does not meet the requirements of Article 33 (3) PCT, because the subject-matter of claims 1-3, 5-7 does not involve an inventive step.

3.1 The problem to which the application is addressed to is the simultaneous production of electricity and carbon dioxide.

3.2 The problem is known in the prior art and solved in alternative ways.

Document D1 discloses a MCFC which is fed by natural gas (page 11, 0116). Cathode and anode off-gasses are partially recycled during the process. PSA units are used within the

process to enrich carbon dioxide. A portion of this rich carbon dioxide gas is distracted, the remaining portion is recycled back to the enriched oxygen compressor which provides a suitable cathode stream (page 12, 0121). At the anode the off-gas is burned in a combustion unit and then cooled to condensate water and led to a further PSA unit.

Document D2 discloses MCFC cell which cathode is supplied with an oxygen enriched gas stream containing carbon dioxide. The oxidant stream uses at least 95% v/v of oxygen in the gas. The cathode off-gas still contains carbon dioxide and oxygen which is mixed with fresh oxidant and recycled back to the cathode inlet to optimize the carbon dioxide losses.

Document D3 discloses a MCFC comprising heat exchangers and catalytic burners. The anode off-gas is heat exchanged to remove water and combined with the fuel supply and recycled back to the anode. The cathode off-gas is combined with fresh oxidant and supplied to the cathode.
Further, part of the anode off-gas is supplied to a catalytic burner where the off-gas is burnt with a oxidant. The resultant gas is combined with the stream containing cathode off-gas and oxidant and is recycled back to the cathode leading to a carbon dioxide rich gas stream.

A person skilled in the art with the knowledge of D1 and the problem to produce carbon dioxide in an efficient way, parallel to the normal electricity production would recognize the advantages disclosed in D2 and D3. These are especially the use of an oxidant stream which is almost free of nitrogen to ensure a proper molar ratio of carbon dioxide and oxygen in the cathode feed stream, leading to a carbon dioxide rich off-gas stream. Secondly, the use of a catalytic burner to burn a combination of oxidant and anode off-gas to generate a carbon dioxide rich stream which is again combined with an oxidant stream and fed to the cathode. To distract carbon dioxide from the cathode off-gas when reaching a certain concentration is also known in the prior art. These optimization steps lead to the current subject-matter of independent process claim 1.

Therefore, the subject-matter of claims 1-3 and 5-7 is not considered as inventive.

4. Industrial Applicability

The subject-matter of the present application is industrially applicable in the field of carbon

dioxide generation using fuel cells.